THE EXPLOSIVES ENGINEER

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Forerunner of Progress in Mining, Quarrying, Construction

Island Creek Coal Company made the first shipment of coal from its mines in West Virginia in 1904. During the following 50 years, the company mined and sold more than 273 million tons of coal, a practical indication of the value that consumers placed upon its products and services.

The methods used in Island Creek's mining operations vary to fit the type of mine and the market served by its output. In all cases, mechanization is the rule of the day.

For a description of the activities of one of the leading companies in the coal industry of the United States, please turn to page 103.

* * *

Within a comparatively short period after the completion of an 81-mile-long aqueduct between two reservoirs in southern California, expanded industrial activities and an increase in population around the San Diego area created an urgent need for more water. A second aqueduct, similar to the existing unit, had to be constructed.

A summary of the operations of S. A. Healy Company of Chicago on the southern sections of the line, involving the excavation of 526,000 cu. yd. of variable material, is presented in the article beginning on page 108.

* * *

In the latter part of 1950, Hewitt S. West acquired property in a desert area 6 miles east of Henderson, Nevada, which contained a deposit of manganese. He formed a company under the name of Manganese, Inc. After a series of tests indicated the feasibility of commercial processing by the flotation process, operations got under way in September, 1952. Two contracts were made to supply the national stock pile with 33 million units of metallurgical manganese in the form of nodules.

Variable ore grades, blasted and recovered from 20-ft. benches in two open pits, are mixed in blending piles to provide for uninterrupted work cycles.

A resumé of the procedures at the Henderson property will be found on page 112.

* * *

When Japanese armed forces attacked the Philippine Islands in December, 1941, mine operators on the islands were suddenly confronted with the problem of keeping their stocks of industrial explosives out of the hands of the enemy. Baguio Gold Mining Company had to store 1,400 cases of dynamite in a drift in its underground mine, after which the area was flooded with water.

Recently, the company's operating staff removed the dynamite from the mine. The explosives had been submerged under 100 ft. of hot water for a period of 13 years. A brief description of the methods employed will be found on page 117.

* * *

The shutdown of Hanna No. 4-A mine of The Union Pacific Coal Company on March 1, 1954, ended a brilliant career of mining activities in Wyoming, which started in 1889 and continued uninterruptedly for 65 years. Operations were suspended because of the change-over of the Union Pacific Railroad Company to diesel engines.

Some of the highlights in the life span of the Hanna mine are presented in the article beginning on page 118.

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Views and opinions expressed by the authors of articles in this publication are their own, and they do not necessarily represent those of the publisher.

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SUBSCRIPTION RATES: *United States and Canada*—One Year, $1.50; Single Copies, $.30. *Limited Subscriptions Only to Other Countries*—One Year, $2.50; Single Copies, $.50.

THE EXPLOSIVES ENGINEER, 913 DELAWARE TRUST BUILDING, WILMINGTON, DELAWARE. PRINTED IN UNITED STATES OF AMERICA.

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Le Roi Air Power helps beef up your profits

Le Roi-CLEVELAND Sinkers — with their strong rotation, powerful blow, fast drilling speed, and easy holding, have what it takes to drill more feet per shift. Shown is the 18-lb. H-22 in a stone quarry. Le Roi-CLEVELAND Sinker sizes range from 18 to 80 lbs.

Le Roi-CLEVELAND DR-30 Wagon Drill — Air-powered by a 600-Airmaster, this wagon drill puts deep holes down faster, with less air than any other wagon drill available. Its 4-inch bore, Le Roi-CLEVELAND Drifter has strong rotation, powerful hole-cleaning ability and high drilling speed with big bits. For shallow holes, the lightweight Le Roi-CLEVELAND DR-34 is available.

Le Roi-CLEVELAND Paving Breakers — really pack a wallop. They are available in sizes from 18 to 80 lbs. Their powerful force of blow is ideally suited for the toughest concrete. This feature, plus easy handling, makes them a favorite with operators who like to get a lot of work done. A protective air cushion in the front end keeps maintenance costs to a minimum.

Le Roi-CLEVELAND SB30 Pipeline Rig — This adjustable, multiple drill rig, consisting of four, 4-inch, air-feed drifters hung from a side-boom tractor, was pioneered and developed by Le Roi-CLEVELAND for trenching in hard rock. Because of its flexibility and drilling power this rig is also ideal for cutting costs on road jobs or wherever you have big rock cuts. On this road job in Pennsylvania the SB30 drilled 275-300 feet per hour.

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More footage!
More profits!

Le Roi Airmaster running 2 Le Roi-CLEVELAND Model 52 80-lb. breakers. Airmasters are available in 85, 105, 125, 185, 210, 250, 365, and 600-cfm sizes; gas or diesel.

...that's why it pays you to use Le Roi Airmaster Compressors and Le Roi-CLEVELAND Air Tools

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C-153

CARL McFARLIN, JR.

Carl McFarlin, Jr.

VICE PRESIDENT AND CHIEF ENGINEER

TENNESSEE PRODUCTS & CHEMICAL CORPORATION

A Biography

FROM VERY EARLY BOYHOOD, Carl McFarlin, Jr., vice president and chief engineer of Tennessee Products & Chemical Corporation, thought and dreamed of the coal-mining business. This was only natural because he was literally born into the business: his grandfather, Will McFarlin, was associated with the industry in Alabama for many years; his father has been prominently identified with coal mining since 1920. (The January, 1935, issue of THE EXPLOSIVES ENGINEER presented the biography of Carl, Sr., currently president and general manager of Tennessee Products & Chemical Corporation.)

Carl, Jr., was born in Stringer, Mississippi, on August 7, 1921, the son of Carl and Hetty Ware McFarlin, and spent his early life in Birmingham, Alabama. After completing the prescribed courses in the local public grade schools, he prepared for college at McCallie School in Chattanooga and at Montgomery Bell Academy in Nashville, Tennessee. During his prep school days, young Carl starred on the varsity football teams. Following his graduation from the academy, he matriculated at Vanderbilt University and was graduated in 1943 with a degree in chemical engineering.

Soon after completing his studies at Vanderbilt, Carl went to work for Tennessee Products & Chemical Corporation as a project engineer. He had laid the groundwork for this association by working in various jobs for the corporation during school and college vacation periods: one summer found him in its hardwood distillation plant, another in the chemical laboratory at its ferromanganese furnace, and a third as a supervisor in manganese ore mines in Cuba in which the corporation had an interest.

In his first assignment as a project engineer, his duties included the opening of the Reel's Cove coal mine of TP&CC at Whitwell, Tennessee. It was at a time when the United States was engaged in World War II and coking coal was in urgent demand, and manpower, equipment, and materials were at a premium. Notwithstanding such odds, the McFarlin team of father and son brought forth at the Reel's Cove mine a model of mechanized coal-loading and coal-handling operation. It stands as a tribute to the father's vision and to the energetic cooperation of Carl, Jr., and his associates.

In 1944, Carl joined the United States Navy and, as a lieutenant aboard patrol craft, saw service, mainly in the South Pacific.

After his discharge in 1946, he returned to Tennessee Products & Chemical Corporation as chief engineer. Two years later, he was promoted to assistant vice president and a member of the board of directors. In 1950, he was elected the vice president of the organization and at the same time retained his duties as chief engineer with general supervision of coal-mining operations and the company's research department.

An ambitious expansion program has been carried through succesfully under Carl's supervision. It included the construction of chemical plants at Chattanooga, Tennessee, and Wichita, Kansas; the building of a ferro alloy plant at Houston, Texas, and Chattanooga, Tennessee, and a perlite plant at Jacksonville, Florida; and the rehabilitation and modernization of the Rockwood furnace plant. His duties necessitated extensive traveling in Europe, Mexico, and Cuba.

In addition to his responsibilities with Tennessee Products & Chemical Corporation, Mr. McFarlin is president of Tennala Pipe Company and Somerville Iron Works, Inc.; and a vice president of Rockwood Slag Products, Inc., Tenn-Tex Alloy & Chemical Corporation, and Southern Ferro Alloys Company. He is also a member of the board of directors of these companies.

He holds memberships in the American Chemical Society, the American Institute of Chemical Engineering, the American Iron & Steel Institute, the American Foundrymen's Society, the Southern Association of Science and Industry, Inc., and the Nashville Engineering Association. His club memberships include the Cumberland, Richland Golf, Kiwanis, and Junior Chamber of Commerce.

Carl McFarlin, Jr., married Gayle Gayden on June 5, 1943, in Nashville, Tennessee. They have two daughters, Gay and Helen. The family home is at Valley Brook Place in Nashville, Tennessee.

Carl is an enthusiastic sportsman, with special fondness for hunting and fishing expeditions with his family and friends. Another hobby high on his list is painting, the subject matter of which is dictated by his friends.

Editorial

Planning and Executing Primary Blasts

Preparations for making primary blasts usually involve heavy investments for drilling, explosives, labor, and general overhead. Such investments should be protected by exercising proper care all along the line. A hurry-up job of loading explosives into drill holes, followed by too much speed in making connections and firing blasts, often results in serious, even disastrous, consequences. Long delays between drilling holes and firing blasts often cause trouble. The dangers of premature blasts, with possible injuries to workmen and bystanders and damage to property, are such as to demand proper attention to details.

Rushing to fire blasts at prearranged times, or to get the work done before dark or the arrival of approaching electrical storms, creates confusion in many cases. Even experienced crews often make mistakes when their routines are changed. Holes become plugged, breaks occur in the wire connections or in the firing line, and other errors go undetected. And, finally, when the time comes to fire blasts, too much speed and carelessness are especially dangerous and sometimes result in loss of life, limb, or property.

The men delegated to fire blasts by closing electric switches or operating blasting machines must have unobstructed view, for they must know that the blast areas are clear of people and things that could be injured or damaged.

Every operator who uses industrial explosives in his work should see to it that rules are made, and strictly enforced, which prohibit hurry-up assignments in the planning and execution of primary blasts.

Excavating Drainage Ditches With Dynamite

As a quick and economical agent for the excavation of trenches and drainage ditches in wet, marshy areas, dynamite has proved to be a great benefactor, particularly to the farmer and the contractor. The same properties that enable explosives to serve agriculture and the construction industry make them important to the improvement of water-soaked areas which, for reasons of immediate strategy, must be quickly converted into sites for airfields, cantonments, highways, or war plants. Propagated ditch blasting to effect drainage of swampy land is the most frequently used technique and, perhaps, the one of greatest potential usefulness in the field of the military.

A number of specialized types of industrial explosives are available to meet the requirements of ditch blasting. Their effective employment requires close adherence to the proper determination of gradient, the clearing of the right-of-way, the spacing and loading of holes, and to other factors based on cumulative experience.

Ditching with dynamite has a number of advantages over hand or mechanical methods, some of which are of particular significance in eliminating delays and minimizing costs. Some of the principal advantages are:

Dynamite does the job quickly.
Handling of debris is eliminated.
Equipment and workmen can be used elsewhere.
Grading and surfacing machinery can be put to work with a minimum of delay.

Enroll Your Mine or Quarry In the National Safety Competition

The results of the National Safety Competition of 1953, presented in our May-June issue, showed an enrollment of 583 mines and quarries located in 41 states. The competing units, representing a total of 156,798,125 man-hours of work, made the best overall safety record in the 29-year history of this nation-wide contest. Perfect safety records were reported by 197 mines and quarries, representing a working time of 17,662,589 man-hours.

The effectiveness of these annual safety contests as a practical means of promoting safety at mineral operations is clearly shown in the records. Statistics reveal that, year after year, the average mine or quarry participating in the competition has a better safety record than the average mine or quarry in the country not enrolled in the contest.

Page after page has been written about the responsibility of the employer in making available to his men the tools and the methods to eliminate accidents. It is a lofty thought that a company does consider the well-being of its employes as a vital adjunct to its operating program.

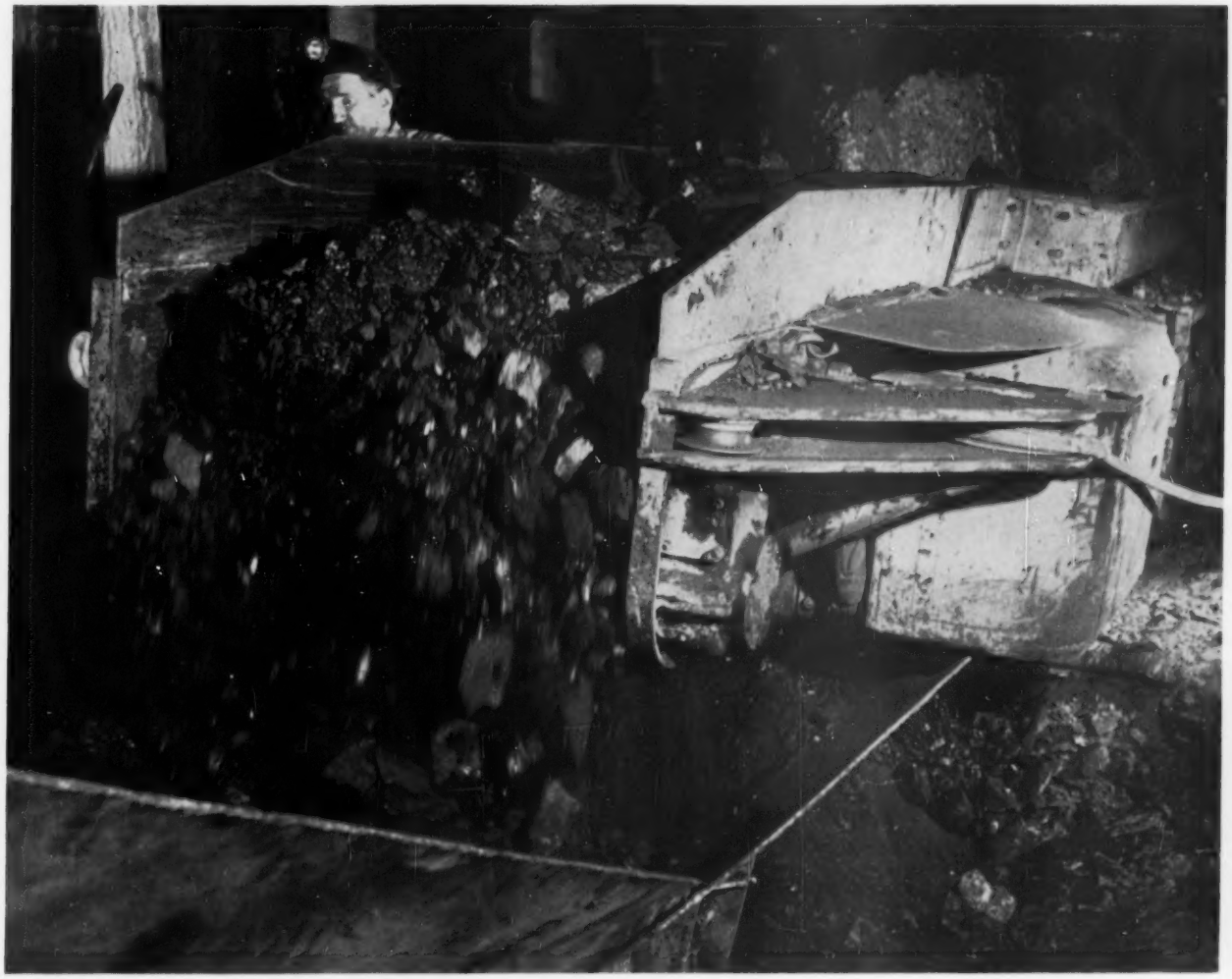
We urge you to enroll your company today in the National Safety Competition. It offers you an opportunity to enter into a nation-wide safety crusade.

Any underground mine, open-pit operation, or quarry in the United States is eligible to enter the competition. Applications for enrollment and copies of the contest rules may be had by communicating with the Bureau of Mines, U. S. Department of the Interior, Washington 25, D. C.

Don'ts for Explosives Users

Don't tamp with metallic bars or tools. Use only a wooden stick with no exposed metal parts.

Don't use combustible material for stemming.



ISLAND CREEK COAL: Coal from an underground working place is unloaded from a shuttle car onto an elevator which, in turn, delivers and loads it into rail cars for hauling to the surface by electric locomotives.

ISLAND CREEK COAL COMPANY'S GOLDEN ANNIVERSARY

More than 273 million tons of Island Creek products have been delivered to markets in the United States and foreign lands during the past 50 years

A. L. LYNN and J. H. GREEN*

IN 1904, men of vision predicted amazing things in the years ahead — new products, new methods of production, new territories of opportunity, and new ways of life for all mankind. Men in Detroit, Pittsburgh, New York, Washington, and elsewhere were combining their resources and skills in efforts to supply the American consumer with what he wanted, when he wanted it. Yet, none of these "visionaries" could foresee that within the comparatively short span of 50 years half of our nation's people would be gainfully employed in enterprises not even thought of in 1904.

Industrial progress in 1904, as at present, was largely dependent upon the development of power. Recognizing that coal was a basic resource for the development of power, two far-

*Island Creek Coal Company
Guaranty Bank Building
Huntington 18, West Virginia

sighted men ventured into the rugged mountain areas of southern West Virginia. Albert F. Holden, an engineer, and William H. Coolidge, an attorney, were corporate officers of United States Oil Company, which later became Island Creek Coal Company. Through their efforts, property aggregating 28,000 acres of coal land was purchased in Logan County, West Virginia. The town of Holden was founded as the center of operations. Before railroad connections with the outside world could be made, machinery, equipment, materials, and other necessary commodities were hauled by ox teams through some 12 miles of terrain to Holden.

First Shipment of Coal

With the completion of railroad facilities, Island Creek Coal Company sold and shipped its first coal in December, 1904. During the following 50 years, the company has sold more than 273 million tons of coal, a practical indication of the value which consumers have placed upon Island Creek products and services.

Through the years, the management personnel of the company has been on the alert for new and improved operating methods and techniques. They have worked continuously to utilize the highest standards of mining and preparation in the industry. These efforts have been rewarded by a steady and healthy growth in the demand for Island Creek products and have gained for the company a position of leadership in the coal industry in the United States and foreign lands.

As previously stated, more than 273 million tons of Island Creek products have moved to the markets during the past half century. If this huge tonnage were loaded into coal cars and connected in a single train, it would be 33,000 miles long and, traveling at a rate of 60 miles an hour, would require 23 days to pass a given point. Island Creek's reserves of unmined coal exceed the tonnage already marketed, supporting an annual production capacity in excess of 10 million tons.

Mechanization is the Rule

The mining methods used in the company's operations vary to fit the type of mine and the market served by its output. Certain types of mechanical equipment are preferable in some instances; in others, totally different kinds are used. In all cases, mechanization is the rule of the day. The mine employes are skilled operators of heavy, fast-moving, bulk-handling mechanical units; in fact, there isn't a pick or shovel in any of the underground properties of Island Creek.

Usually, the required equipment or machinery is available from manufacturers. But, when Island Creek's production team needs a special kind of mechanical unit it is not unusual for the men to go to the drawing board and design what is needed and to produce it in the company's modern shops.

POWERFUL COAL CUTTER: This modern mechanical unit with long, powerful, sawlike teeth is being moved to a working place to cut into the sides and center of a coal face.

Blasting The Coal

After the coal is undercut in a typical working place underground, usually a 22-ft.-wide cut, the coal face is blasted in the following manner. Seven holes 2¼ in. in diameter are drilled into the coal to the depth of the undercut, about 8 to 8½ ft. Four of the holes are drilled across the top of the face, start-

ANOTHER CUTTING OPERATION: A close-up of a Joy 11-RU Universal cutting machine at work removing a boney section in a coal face in one of the Island Creek mines.

DRILLING BLAST HOLES: After the coal is cut, seven 2¼-in.-diameter holes are drilled into the face by electrically powered auger drills.

AFTER A BLAST: A look at a loading machine as it scoops up broken coal following a blast of permissible dynamite charges in an underground working place.

SHUTTLE CAR: This shuttle car operator is moving his equipment into a working place to take on blasted coal from a loading machine for delivery to the main haulageway.

ing 2 ft. in from the left side, with the holes spaced on 6-ft. centers. The other three holes are staggered below the upper row of holes, starting 5 ft. in from the left side, with 6-ft. spacings between holes. The average charge of explosives loaded into the drill holes is 20 cartridges of Hercules® Red H® F permissible dynamite packed in 1¾ by 6-in. cartridges. The charge of dynamite in each hole is primed with a No. 6 detonator with 10-ft. iron leg wires. All of the charges are stemmed to the collar of the holes with clay tamping. Only one loaded hole is fired at a time, beginning with the middle hole in the bottom row. Detonation is accomplished with a permissible blasting machine. The blasting crew concentrates on producing a maximum of coarse or lump sizes of coal from each blast.

Preparation and Sizing

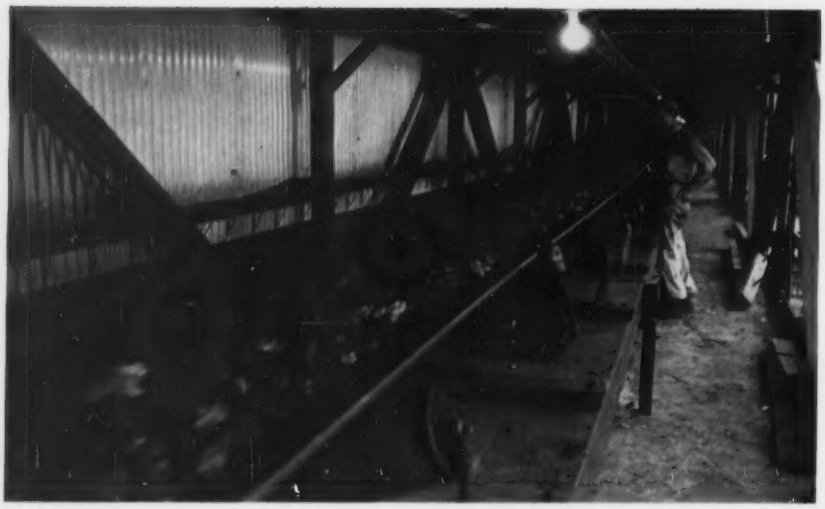
The preparation and sizing of coal are important in realizing a quality product. In Island Creek's 13 preparation plants, among the most modern in the coal industry, the coal is sized, wet-washed, dewatered, heat-dried, graded, blended, and oil-treated — "manufactured" to meet exacting requirements. The products are manufactured in a variety of sizes for a wide range of uses in all types of coal-burning equipment, as well as in other processes of coal utilization.

Size consist is particularly important in obtaining minus 2-in. coal. Since the percentage of various component sizes in 2 by 0-in. screenings will vary between mines and coal seams, Island Creek began years ago to control these variations so that the consumer would benefit from consistency of preparation, and the blending of specific size components best suited to his needs.

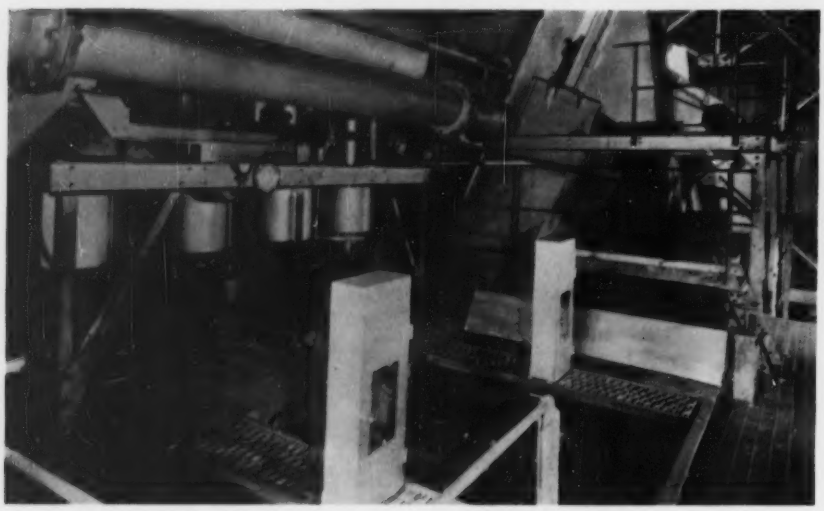
In order to accomplish this result, the minus 2-in. sizes are separated into standard-sized components and fed to bins from which each component size is later discharged by means of mechanical feeders in the desired proportions. This method assures a uniform product with a size consist predetermined to a certain specification.

Quality Control

While years of experience have demonstrated that the described mechanical method of blending and controlling



CONVEYOR BELT: The mined coal is moved to the preparation plant on a conveyor belt at an average rate of 500 tons an hour.



WET-WASH BOX: Raw coal passes through this wet-wash box, one of the units used in the cleaning process in Island Creek's preparation plants.

VENTILATING FANS: Huge fans, like the two shown above, assure adequate ventilation in the company's underground operations, where air is measured in millions of cubic feet.

size consist is accurate, with a minimum deviation from car to car, size-consist tests are made regularly each day at each operation. The method provides positive control over every phase of Island Creek's mining and manufacturing processes by superintendents, inspectors, engineers, and chemists.

The high degree of market acceptability for Island Creek products is due, in no small measure, to the company's ability to mine and manufacture coals which are adaptable to the modern demand for increased plant-operating efficiencies in industry, to new stan-

MAINTENANCE SHOP: Repairs to mining equipment are taken care of in underground maintenance shops. "Down time" of mechanical units is reduced to a minimum.

dards of comfort in the home, and to rigid quality requirements for special sizes of coal.

Another facet of Island Creek's operations is the services rendered by its wholly-owned subsidiary, Island Creek Fuel and Transportation Company, which owns and operates a fleet of towboats and 100 barges of approximately 1,000-ton capacity each on the Ohio River. This company has a railroad car-to-barge unloading facility at Huntington, West Virginia, with a capacity of 6,500 tons per eight-hour shift. Also, it maintains an elevator and screening plant at Cincinnati, for unloading

(Continued on page 123)

RAYMOND E. SALVATI: Island Creek Coal Company's president is also active in many civic and industrial organizations, including the National Coal Association, the American Mining Congress, and the National Association of Manufacturers.

PREPARATION PLANT: The photographer took a picture of two Island Creek employes talking things over outside one of the company's 13 preparation plants, which are numbered among the most modern in the coal industry.

RIVER TRANSPORTATION: A company towboat moves barges loaded with Island Creek coal up the Ohio River from Huntington, West Virginia, to its elevator and screening plant at Cincinnati, Ohio.

CONSTRUCTING BARREL NUMBER TWO FOR SOUTHERN CALIFORNIA'S SAN JACINTO–SAN VICENTE AQUEDUCT

HILLS AND VALLEYS: This view of a line of pipe in place on the Barrel Number Two aqueduct project is representative of the variable terrain encountered on the three southern sections. Making satisfactory progress in drilling and blasting in hard granite formations on deep sloping mountainsides requires engineering skill and operating know-how of a high order.

Excavating 71 miles of deep, wide trenches to lay 54- and 48-in. concrete pipe through variable terrain with widely different grades requires engineering skill and operating know-how of a high order

C. O. MAYER*

An 81-mile-long aqueduct, extending from San Jacinto Reservoir to San Vicente Reservoir in southern California, was completed in 1947. It was designed by the U. S. Bureau of Reclamation to draw water from the facilities of the Metropolitan Water District and to deliver ample supplies to the ever-growing military and civilian activities in and around the San Diego area. The work details involved the construction of the San Jacinto Reservoir at the northern terminus, the driving of tunnels through sections of rugged mountains, many miles of trench excavation, and the laying and backfilling of precast concrete pipe in the trench. All of the construction contracts were sponsored, engineered, and supervised by the U. S. Navy.

Within a comparatively short period after the aqueduct was completed and in operation, an increase in population and expanded activities in the San Diego area created an urgent need for still more water. A second aqueduct, similar to the existing unit, was found to be essential. In due course, the necessary arrangements were made, bids for construction were received,

*Hercules Powder Company
San Francisco 4, California

and contracts were awarded to the low bidders.

The tunnels constructed through the mountains for the original aqueduct, referred to locally as Barrel Number One, had been driven to full capacity in proportion to the capacity of the pipe line. Accordingly, it was not necessary to enlarge the tunnels or to drive new ones for the second aqueduct, or Barrel Number Two. Because of this, the length of the second aqueduct is approximately 71 miles, 10 miles shorter than the first aqueduct.

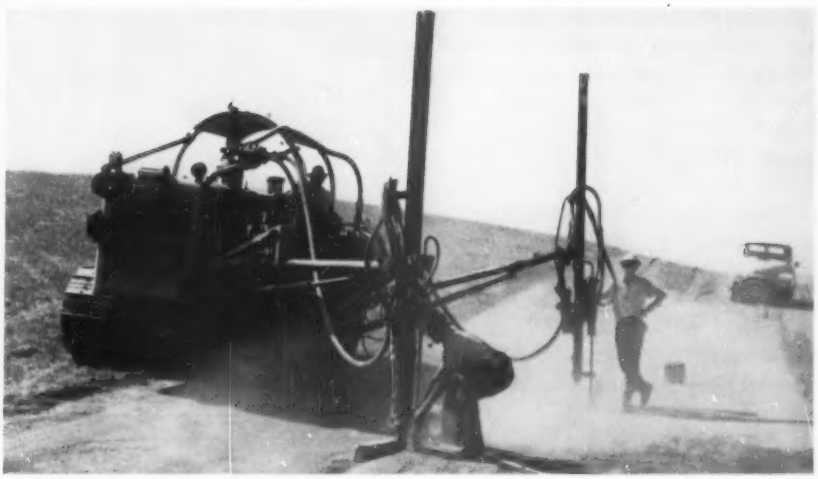
Construction Work Divided Into Six Schedules

In the construction of Barrel Number Two the principal items of work were divided into six schedules, designated as Numbers One, Two, and Three North and Numbers One, Two, and Three South. One other unit, a siphon and river crossing at San Lui Rey River, was set up as a separate contract. The river-crossing location was the dividing line between the north and south sections.

Southern California contractors were successful bidders on the contracts for the three northern sections and for the river-crossing job. Work was started in the north at the outlet of the San Jacinto Reservoir, and will end in the south at the inlet portal of the San Vicente tunnel. At the time this was written, March, 1954, the three northern schedules and the river-crossing job were 99 per cent completed.

The low bidder on the three southern sections was S. A. Healy Company of Chicago, Illinois, with a bid of $6,798,101. The specifications on the Healy contract include the excavation of 526,000 cu. yd. of variable material; the laying and backfilling of 29,074 ft. of 54-in. and 122,478 ft. of 48-in. precast concrete pipe designed to carry 85 c.f.s.; the installation of manholes, blow-offs, and vents; a chlorination station; and a turnout and metering station at the southern end of the project. At the time of the writer's visit in March, about 75 per cent of the work on the three southern sections had been accomplished. Final completion date is estimated for September, 1954.

A plant to make concrete pipe for the Healy company's requirements



UNIQUE DRILL RIG: This unique drill rig includes two Joy hydraulic jib booms, each supporting a 3½-in. Joy wagon drill mounted on a D8 "Cat" carrying a 600-c.f.m. compressor.

BLAST IN MOTION: A view of a blast in motion immediately after the detonation of the explosives charges in a series of drill holes along the trench line. Results from blasting are consistently satisfactory.

NEAT, UNIFORM TRENCHES: After blasting, an 80D Northwest 2½-cu. yd. backhoe excavates broken material along the trench line. Neatness and uniformity in completed sections of the trench are typical of the S. A. Healy Company's operations.

was erected at Fontana, California, by the Basalt Rock Company of Napa, California. The pipe is transported to the project by truck and cradle-type trailers. The haul, one way, is approximately 80 miles.

The 54-in. pipe is made in sections of 16-ft., and the 48-in. sections in 20-ft. lengths. The difference in length of the two sizes of pipe was established to take advantage of the full-load limit of the highways, to help facilitate manufacture, and to speed pipe-laying operations.

Making Progress Through Variable Terrain

Making satisfactory progress in excavating the trench and in laying the pipe through the variable terrain on the three southern sections calls for engineering skill and operating know-how of a high order. In flat agricultural areas, well points are used to drain water from the excavated trenches before the pipe is placed. In mountainous regions, solid rock is drilled and blasted on widely different grades, with some of the slopes ranging up to 45.3 per cent.

Most of the trench is excavated to a width of 7 ft. regardless of the size of the pipe to be laid. The depth of the ditch is excavated so that a minimum of 3 ft. of backfill covers the pipe in place. The depth of ditch is, of course, dependent entirely on the hydraulic gradient required.

For drilling holes for blasting in rock sections, the Healy crews use a combination of drilling equipment. A rather unique and successful drill rig consists of two Joy hydraulic jib booms, each carrying a 3½-in. Joy wagon drill machine mounted on a D8 Caterpillar tractor, which also carries a 600-c.f.m. compressor. This assembly completely eliminates the slow, arduous task of moving the drills manually. Other drill equipment includes eight 4-in. Joy wagon drills and four 600-c.f.m. Chicago Pneumatic compressors. Conventional steel Rok-Bits are used for drilling in average-type rock. In hard blue and gray granites, carbide insert Rok-Bits are used.

Consistently Satisfactory Results From Primary Blasts

Several drill patterns have been developed which, except in rare instances, break the rock in the bottom and on the sloping sides of the trench. In decomposed and medium-hard granite, three holes are drilled across the trench line, one in the center of the line and one on each side, each 3 ft. from the center hole and 6 in. from the sides of the trench. Similar holes are drilled in rows along the trench line, with the rows 5 ft. apart. Each hole is loaded with Herculite® 40% Bag Powder on a ratio of ½ to ¾ lb. of explosives to 1 cu. yd. of rock in the solid. A "booster" charge of one 1¼ by 8-in. cartridge of Gelamite® 1 is loaded with the main charge in each hole. The explosives charges are primed with Hercules® Short-Period Delay Electric Blasting Caps. In hard granite formations, the rows of holes are pulled in from 5-ft. to 3-ft. centers, and the explosives loading ratio is increased to 0.8 to 1 lb. of dynamite per cubic yard of rock in place.

In areas where very hard granites are encountered, particularly on slopes where backhoe operations are difficult, five blast holes are drilled across the trench line, with the rows of holes 3 ft. apart. In such cases, the holes in the center line are sprung with a 1¼ by 8-in. cartridge of Gelamite 1, after which they are loaded with Herculite 40% Bag Powder on a ratio of 1.5 to 1.75 lb. per cubic yard.

DEWATERING THE TRENCH: Before pipe was laid in this section of Barrel Number Two, Healy crews used well points to drain water from the excavated trench line.

PLACING THE PIPE: The necessary compaction of backfill prior to the placement of pipe is obtained satisfactorily by the employment of a Mighty Mouse tractor equipped with a Jackson vibrator.

WATERTIGHT CONNECTIONS: After sections of pipe have been placed in the trench, a self-contained mixer and boom conveys cement to the grouting crew to make watertight connections.

Short-Period Delay Detonators Prove Especially Helpful

Because of the consistently satisfactory results obtained from the primary blasts, plug drilling and secondary blasting are rare occurrences. The use of short-period delay electric blasting caps to detonate the dynamite charges has proved to be especially helpful in overcoming several blasting problems. The location of the new trench, Barrel Number Two, practically parallels the existing one, Barrel Number One. In some places, the distance between the center lines of the two barrels is only 20 ft. The danger of cracking or breaking the existing line, Barrel Number One, was a constant hazard. The use of short-period delay detonators reduced the shock and vibrations from blasts to a minimum. To date, there has been no indication of damage to the existing line. The dynamite charges in the row of holes nearest the existing line are always the last to be detonated. This arrangement reduces not only the shock to Barrel Number One, but it improves fragmentation and provides neater slopes along the trench line of Barrel Number Two.

Most of the excavation in the trench line is done with three 80D Northwest 2½-cu. yd. backhoes. At some locations, a Northwest 71 equipped with a dragline bucket was used. The necessary compaction of backfill prior to the placement of pipe is obtained satisfactorily by the employment of a Mighty Mouse tractor with a Jackson vibrator. The placing of the pipe in the trench is done with a Northwest 71 crane and a Lima 802. A 20T truck with a drag bucket attachment is used in backfilling operations. Consolidation of the backfill is done with an HD14 tractor mounted with an Ingersoll-Rand GR210 and two CP 518 internal vibrators.

This second aqueduct project is sponsored by the U. S. Navy. Details of design, engineering, and construction supervision are under the direction of the U. S. Bureau of Reclamation.

Cost Estimates Less Than Appropriation Figure

An appropriation of $18,000,000 was authorized for the job. However, with all construction schedules under contract and the work approximately 85 per cent completed, it is estimated that the total cost will amount to about $16,500,000, considerably under the appropriation figure.

Payment for the operation and maintenance of the new line has been assumed by the San Diego County Water Authority. The Metropolitan Water District of Southern California has assumed 50 per cent of the responsibility by taking over the operation and maintenance of the northern half of the line.

The project offices of S. A. Healy Company and the Bureau of Reclamation are located in Escondido, California. Operating directors for the Healy organization include Nicolas Marsch, project manager; Paul McCabe, general superintendent; Al Belongia, assistant superintendent; Dick Joplin, project engineer; and Gil Pound, office manager.

Representing the Government agencies on the project are Captain K. A. Godwin, Public Works Officer, Eleventh Naval District, San Diego, California; and L. N. McClellan, chief engineer of design and construction, U. S. Bureau of Reclamation, Denver, Colorado. Jean R. Walton is project engineer for the Bureau with John McCoy, assistant project engineer, and Hubert Williams, office engineer. For the Metropolitan Water District, R. B. Diemer is chief engineer and general manager. Richard Holmgres is chief engineer and general manager for the San Diego County Water Authority.

PROJECT SUPERVISORS: Operating details on the Healy contract were directed by, left to right, Paul McCabe, general superintendent; Gil Pound, office manager; and Dick Joplin, project engineer.

MINING MANGANESE ORE NEAR HENDERSON, NEVADA

Variable ore grades, blasted and recovered from 20-ft. benches in two open pits, are mixed in blending piles to provide for uninterrupted work cycles in mining and mill operations.

ROBERT LEE BEHME*

IN 1917, a manganese deposit was located in a typical southwest desert area 6 miles east of Henderson, Nevada. By the fall of the following year, about 12,000 tons of ore assaying about 40 per cent manganese had been produced. Operations were conducted under the name of the Three Kids mine, with activities restricted to a small open pit. During 1920, mining activities were moved underground. Within a short time the immediate supply was exhausted and the mine became inactive.

During the mid-1930's, experiments on the ore were initiated and tests indicated a possible recovery of only 70 per cent by flotation. In 1941, additional test work done at the Boulder City pilot plant of the U. S. Bureau of Mines confirmed the recovery mentioned. At the same time the M. A. Hanna Company completed test work utilizing an SO_2 process with indicated manganese recovery in excess of 90 per cent. Based on this chemical process, the Manganese Ore Co. was formed, but operational difficulties

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La Canada, California

"A" PIT: This view, looking west, includes some of the mining activities in "A" pit, in the southern section of the property of Manganese, Inc., near Henderson, Nevada. The mill is located to the right of the above area.

RECOVERING BLASTED ORE: Following a primary blast in a 20-ft. bench in "A" pit, a 2½-cu. yd. Northwest power shovel excavates the broken ore and loads it into Euclid trucks.

plagued the plant and it was closed in 1944. In 1949, Hewitt S. West began negotiations to acquire the property. By the end of 1950 the negotiations were completed and Manganese, Inc., was formed. Two contracts were made with the General Services Administration to supply the national stock pile with 33 million units of metallurgical-grade manganese in the form of nodules.

Test work was undertaken by Robert Lord of Southwestern Engineering Company and the U. S. Bureau of Mines. The results of these tests indicated the feasibility of commercial processing by the flotation process. Break-in operations began in September, 1952.

In February of the following year, the first of two major setbacks occurred. A kiln failure was of such magnitude that new construction was required before operations could continue. A few months later, when operations had been resumed, a fire destroyed the flotation building. The kilns resumed operations in November and, three months later, the flotation section was again in operation.

The Ore Deposit

The ore is of sedimentary deposit consisting of wad interbedded with lake or playa sediments belonging to the Muddy Creek formation of what is suspected to belong to the Pliocene Age. Where the manganese content is highest, often in excess of 30 per cent, the wad forms massive beds separated by thin, barren partings. Where the manganese content is low, the wad forms very thin lenses or small blebs.

Although the ore is chiefly wad, there are some small amounts of psilomelane present. The ore bed is overlaid with beds of gypsum which outcrop, or are covered with surface gravel. Intermediate beds of red and white tuff occur, and the lenses are red and green jasper with stringers of gypsum or calcite. Small amounts of iron, lead, barite, celestite, and bentonite are present. Since these are made up of minute acicular crystals, the moisture content is very high, averaging about 18 per cent. Reserves of ore have been estimated at 3 million tons averaging about 18 per cent Mn and up to 5 million tons after grade is dropped to 10 per cent Mn.

Open-Pit Operations

The present open-pit operations are located in an area in the southern section of the property, with the plant and mill units between the pits and the Vegas Wash Highway. The pits are divided into two sections, A to the west and B to the east, each butting against the former Three Kids mine. The two pits are separated by a fault running north and south.

All excavation work is done under a subcontract by Isbell Construction Company of Reno, Nevada. Approximately 50 per cent of the ore, representing more than 60 per cent of the manganese, can be mined by the open-pit method. This is a combination of previous methods and developments from experiments by the Isbell Company. The ore remaining will be mined and recovered through underground methods not as yet determined.

Since the ore grade varies between the two pits, it was decided to correlate mill operation for an ore grade between the two limits to set up a more consistent recovery program. The mill, set for 18 per cent ore, must utilize a mixture of the excavations from the two pits. This is accomplished by a haulage-storage system by which the two ores are blended.

The pile of blended ore, representing approximately one month's supply for the mill, is built up with alternate layers of ore from A and B pits. The thickness of the layers is calculated to allow for a schedule which permits the drilling, blasting, and loading crews to work uninterruptedly.

PREPARING TO BLAST: A close-up of the Joy 225-A rotary unit drilling a 4¾-in.-diameter hole on a bench in "B" pit preparatory to blasting the ore.

Drilling and Blasting

A work cycle begins with the drilling and blasting crews moving into a freshly excavated pit to begin operations on benches 20 ft. high. Because of the high moisture content, the ore has a resilience which makes satisfactory drilling and blasting results difficult to attain consistently. After considerable tests had been made by George Laughton, project superintendent for the Isbell company, wagon drills were abandoned in favor of a Joy 225-A rotary drill. This latter unit produces a blast hole 4¾ in. in diameter at a rate of 2 ft. of hole a minute. The drill is equipped with Joy 2¾-in. rotary steel and a 4¾ Varel Rock Tip. Power for operating the rig is supplied by a Joy 500-c.f.m. compressor.

Holes for blasting on the benches vary in depth, with a maximum of 23 ft., spaced on 8 to 9-ft. centers. They are deck-loaded with 4 by 16-in. cartridges of a 30-per cent strength low-velocity bag powder. The charges are primed with short-period delay detonators from 0 to 6 milliseconds. The leg wires of the detonators are connected in series parallel and blasts are fired from a 440-volt power line. Results are uniformly excellent.

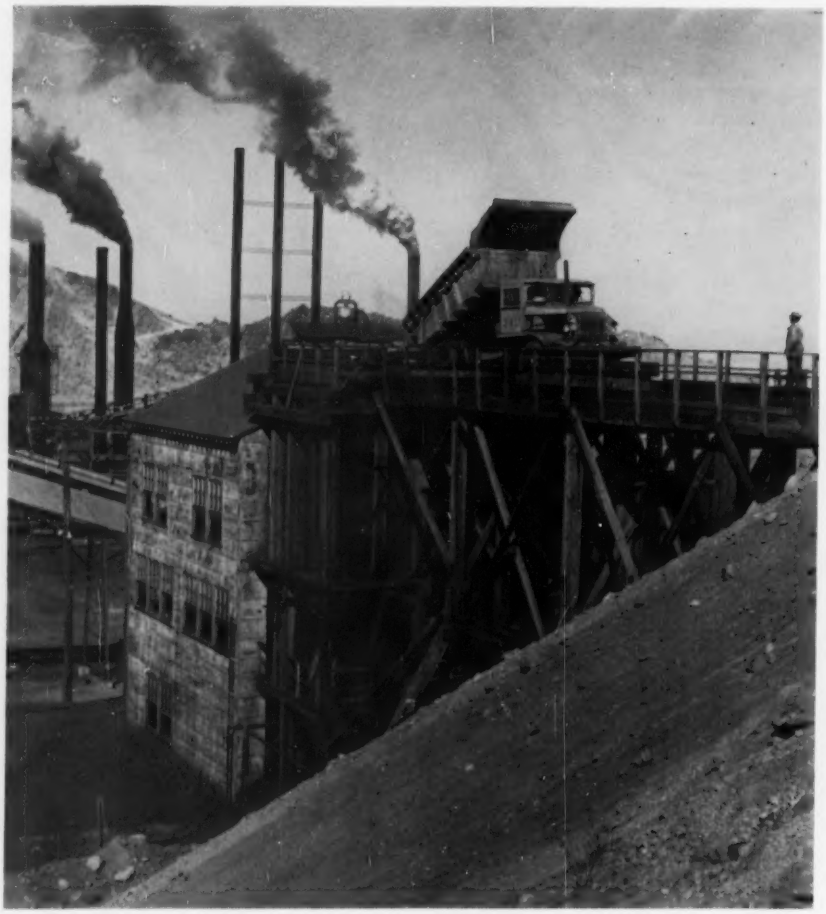
After blasting, the broken ore is excavated by a Northwest 2½-cu. yd. power shovel into two Euclid trucks for hauling to the blending pile located on a bluff about 1,000 ft. from the pit operations. Cleanup work in the pits is handled by a D7 Caterpillar dozer.

When the Euclids unload the blasted ore at a blending pile, it is spread in layers by a bulldozer until 20,000 to 30,000 tons are accumulated. A new blending pile is then started and ore for the mill is loaded out from the first pile by a Northwest 1¾-cu. yd. power shovel into two Euclid trucks. The loaded trucks deliver the blended ore to the chute ramp about 500 ft. distant.

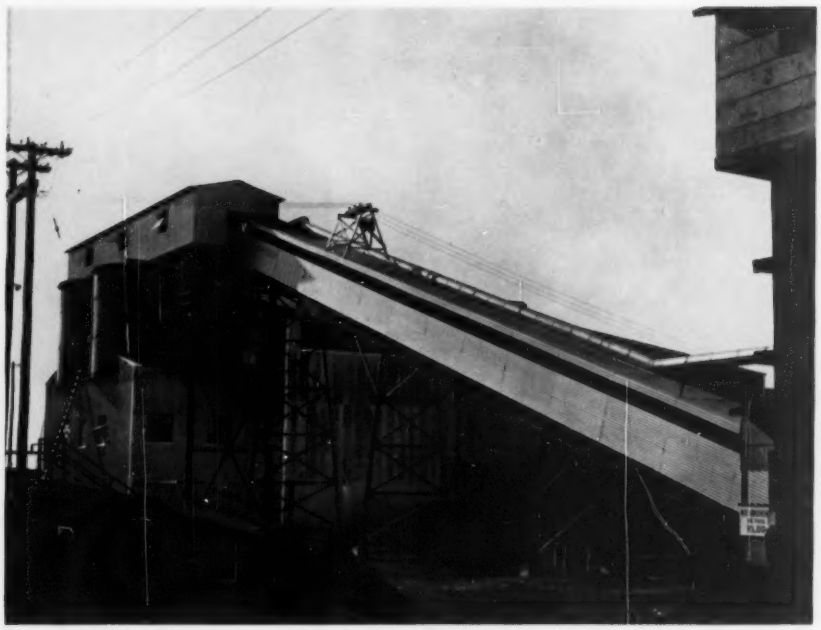
Activities in the Mill

Ore deposited in the chute locates itself in a storage bin, the first step through the vast mill area. More than 20 acres are required in the mill area to take care of storage, crushing, nodulizing, office, and electrical substations. Power is supplied by the Colorado River Commission at 69 kv. to the main substation where the voltage is

"B" PIT: This photograph of "B" pit, looking south, shows the fault in the center background which separates "A" and "B" pit operations.



CRUSHING PLANT: At the crushing plant the 5-in. discharge from the primary crusher is scalped and the plus ½-in. product is fed to a 30 by 30-in. double impact breaker.



NEW, MODERN MILL: Following the destruction of the mill by fire in 1953, this modern, all-metal structure was erected on the site.

NODULES ON PAN CONVEYOR: After the nodules are chilled with cold air and further cooled with water sprays, pan conveyors carry them through a sampling plant to the storage piles.

dropped to 2,300 for distribution to the three substations supplying the crushing plant, flotation plant, and kiln section. The primary crusher and rod mill motors operate on 2,300 volts, while the remainder of the plant uses 440-volt current. Water is supplied by Basic Management, Inc., from a 40-in. line that crosses the property.

Ore from the storage bins passes to the crushing section where the 5-in. discharge from the primary crusher is scalped and the plus ¾-in. product is fed to a 30 by 30-in. double impact breaker. A product of 90 per cent minus ½ in. is obtained in an open circuit.

Even though the ore as delivered from the mine contains 18 per cent moisture (or 12 per cent as delivered from the blending piles), the crushing operations create considerable dust. After the ore has passed the primary circuit, via a 30-in. conveyor belt and a Symons screen which sifts for the breaker, the dust is collected with a Sly dust collector system.

A 24-in. belt conveys the ore to a Merrick Weight-O-Meter which is used to record the total output of the crusher plant.

The product is further reduced by putting it through a secondary crusher from where it is moved along to one of several 65-ton storage bins. If the percentage of fines is greater than anticipated, the present plant employs ¼-in. rod deck screens to direct plus ¼-in. to the mills and the undersize to a spiral classifier. The 10-mesh, and finer, material overflows to cyclone classification and the plus 65-mesh material returns for regrinding.

Because of the existence of bentonite in the ore, mechanical classification was impossible. The installation of four cyclones solved this problem.

Soda ash is introduced in amounts of 5 to 20 lb. per ton before the cyclone. Part of the gypsum dissolved during grinding is thus precipitated. A tendency to form insoluble calcium soap has been reduced in this manner. The pulp passes to the conditioners, 46 by 66-in. Fagergren units. The reagents are added to the pulp just prior to entry into the conditioners. The concentrate is passed from the conditioners to flotation. Each flotation circuit uses 66-in. cells for roughing and four stages

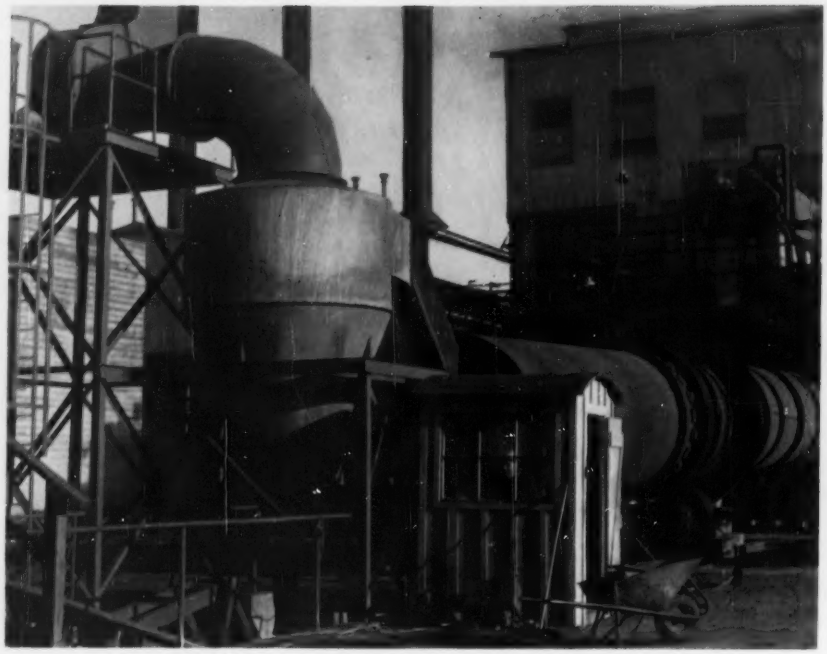
of cleaning. Air is introduced during the roughing cycles and the manganese rises to the surface. The froth is scraped off and the tailings are drained to a tailings pond, west of the mill, near the waste dump pit.

After processing in the rougher, the concentrate undergoes four progressive cleaning stages, after which it goes direct to a filter bank for dewatering. Four 10-leaf Oliver units handle the job and discharge the cake to a 540-ft. conveyor belt which carries it to the first of the kiln operations.

Through the Kiln

At the kiln end of the belt, a splitter divides the incoming cake into equal amounts on a 15-second cycle and directs the concentrate to two sides of the 8 by 150-ft. calcine kilns. The wet cake is self-calcining after the kilns have been brought to 800°F. by oil firing at the discharge end. The calcine discharges through alloy pipes to the nodulizing kiln. As the hot calcine passes down the nodulizing kiln, the temperature is raised to a maximum of 2400°F. about two-thirds of the way down the length of the kiln.

From that point to the end of the kiln, cold air chills the nodules to about 2000°F. The nodules are further cooled with water spray and dropped onto a Stevenson & Adams pan conveyor, which passes through a water spray, for final cooling on their way to the loader. The loader discharges the nodules onto stock piles in the storage area, which is located east of the company offices, just off the highway.



FINAL PROCESSING: After the ore passes through nodulizing kilns (background) and the rotary cooler, it is moved onto a conveyor, then to the belt loader for delivery to storage.

Personnel

Representing Manganese, Inc., at the mine are H. S. West, president; F. A. McGonigle, vice president and general manager; S. J. McCarroll, general superintendent; J. M. West, assistant to the general superintendent; John Atkins, chief mine engineer; John Anderson, mill superintendent; Claude Davis, kiln superintendent; Walter Barney, master mechanic; R. F. Raichlen, electrical superintendent; Russ Waters, plant engineer; Vernon Bell, traffic superintendent; and Victor Howard, mine superintendent.

Isbell Construction Company's operations are directed and supervised by C. V. Isbell, president; W. J. Isbell, vice president; Roy Isbell, secretary-treasurer; Guy V. Isbell, assistant vice president; George Laughton, project superintendent; Dan Grubic, engineer; and Lloyd Sampson, foreman.

ADMINISTRATIVE HEADS: The top officials of Manganese, Inc., are H. S. West, president, right, and F. A. McGonigle, vice president and general manager.

DISCUSSING JOB PROGRESS: George Laughton, project superintendent for Isbell Construction Company, left, discusses job progress with John Atkins, chief mine engineer for Manganese, Inc.

A brief summary of the methods used successfully by the operating staff of Baguio Gold Mining Company in the Philippine Islands

R. B. MAHAN*

WHEN THE JAPANESE attacked the Philippine Islands in December, 1941, the operators of mines on the islands were suddenly confronted with the problem of keeping their stocks of industrial explosives out of the hands of the enemy. At some of the properties, mined-out or relatively unimportant areas underground were quickly utilized to store the explosives, after which the areas were sealed off and abandoned. Other operators had to store their explosives in underground working places, many of which contained valuable ore deposits.

Among the latter group was the Baguio Gold Mining Company at Baguio in Mountain Province. The company had on hand 1,400 cases, 50 lb. each, of 40% and 60% semigelatin dynamite. It was necessary for the Baguio company to store the 70,000 lb. of dynamite in an underground drift containing some of the most valuable ore in the mine. This drift area was of added importance because it figured prominently in the company's future development plans.

*General Superintendent
Baguio Gold Mining Company
Baguio, Mountain Province
Philippine Islands

Dynamite Submerged In Hot Water for 13 Years

The part of the Baguio mine in which the dynamite was stored was below the natural mine drainage. Until recovered and brought to the surface recently, the explosives had been in this underground storage location for almost 13 years, submerged under 100 ft. of water with a temperature of approximately 81 degrees Fahrenheit. The wooden cases containing the dynamite were quite well preserved and sound, with the exception of the nails which were completely oxidized. Before attempting to remove the explosives, each case was tied securely. Upon arrival on the surface, the contents of each case were spread thinly over a large dump area, after which complete burning of the explosives was accomplished.

Although the dynamite was disposed of successfully, another serious problem remained to be solved.

Blasting Pulverizes Floor of Drift

The floor of the drift in which the explosives had been stored for the 13-year period had to be made safe before normal mining operations could begin. The following procedure was adopted: The entire drift area, plus 100 ft. additional at each end, was flooded with water to a depth of 18 in.; bombs were made, each containing six cartridges of dynamite from current stocks, and placed at intervals of 25 ft. along the flooded area; finally, the bombs were fired simultaneously. The detonation of the bombs completely pulverized the floor of the drift to a depth of more than 5 ft. — definite proof that the floor had become contaminated with nitroglycerin. The explosion wrecked all timber in the area for a distance of 600 ft., and 1½-ton mine cars, located 1,200 ft. away from the area, were derailed by the concussion from the blast.

The results convinced the members of the operating staff of Baguio Gold Mining Company that had an attempt been made to fire a blast in a heading in the drift before the bombing of the floor, all workmen within 1,000 ft. of the area would have been killed.

The above details were submitted to THE EXPLOSIVES ENGINEER and are published in the hope that they may be of benefit to others who may be called upon to solve a similar problem.

UNION PACIFIC'S HANNA MINE SUSPENDS OPERATIONS

The change-over to diesel engines by the Union Pacific Railroad Company brings to an end a brilliant record of 65 years of continuous coal-mining activities in Wyoming

I. N. BAYLESS*

THE WINNING of the Sentinels of Safety trophy by Hanna No. 4-A mine of The Union Pacific Coal Company for a perfect safety record during 1953 marks a brilliant end to the activities of a bituminous-coal mine that started to produce in 1889 and was operated continuously until March 1, 1954. On that date, the mine was shut down because of the change-over of the Union Pacific Railroad Company to diesel engines.

Coal was first discovered near Hanna, Wyoming, in 1887-1888. The strata in the area form a huge basin with several seams of coal outcropping around the edges of the basin. The strata pitch steeply on all sides of the basin, leveling off sharply at the bottom. Several large faults are present and tunnels had to be driven to provide passageways through the faulted zones.

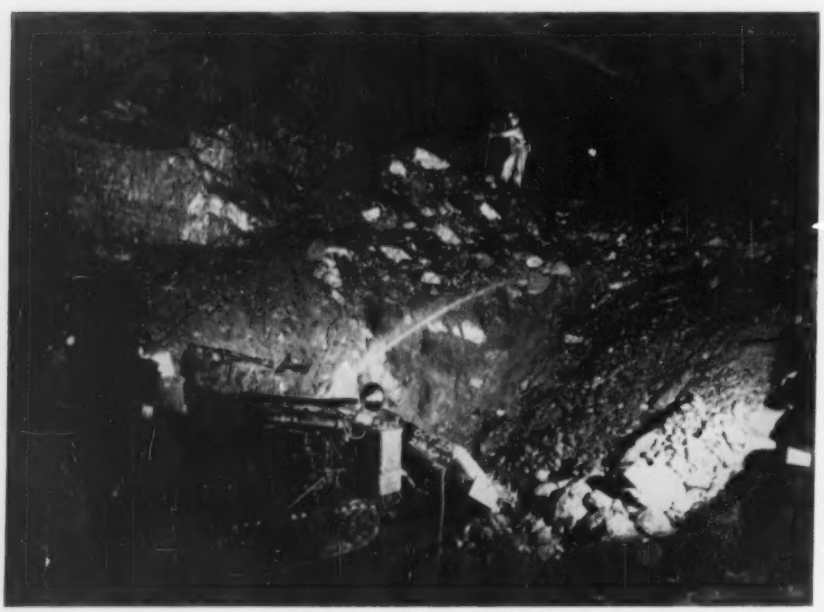
*President, The Union Pacific Coal Company Omaha, Nebraska

The development of a mine at Hanna was started in 1889. Living and working conditions during the first winter months were severe and many hardships were encountered. The miners lived in tents and, to reach the mine portal, they had to struggle through waist-deep snow. As was customary in those days, the usual form of amusement in off-work hours was playing card games, with an occasional "bender" thrown in for good measure. The little mining community continued to grow and, after three years, Hanna had a population of 1,500 and the coal mine had reached full production.

In the ensuing years, two disasters occurred in No. 1 mine at Hanna in which many miners were killed. The first, on June 30, 1903, resulted from an explosion which caused the deaths of 169 men. The second, on March 28, 1908, was the result of a series of explosions which killed 59 men. Of the men killed in the second explosion, 27 bodies could not be recovered. Later, an appropriate monument was placed directly over the mine workings in memory of the brave miners whose ashes rest in this great tomb.

All the mines at Hanna have been slope mines, with strike entries turned at regular intervals as development down the pitch advanced. Entries at Hanna No. 4-A mine were turned on intervals of approximately 1,000-ft. centers. As these entries were advanced toward the mine boundaries, panel slopes were turned off at 700 to 800-ft. intervals and driven up the pitch to the entry above. A hoist was then set in the upper entry, and the mined coal was either hoisted from rooms to this entry or lowered to the entry below. Strike rooms were driven from the panel slopes to a barrier line, leaving a protective pillar between the room and the inby panel slope.

Two seams of coal have been worked quite extensively at Hanna. These are No. 1 seam, 15 to 30 ft. thick, and No. 2 seam, 24 to 32 ft. thick. The exceptional thickness of these coal seams required special methods of mining. At the time of the shutdown, the following procedure was prevalent: Rooms were driven 24 ft. wide on 80-ft. cen-



LOADING HANNA COAL: An underground picture of coal being loaded from a top coal pile in Hanna No. 4-A mine. A stream of water is being sprayed onto the coal pile for dust control. Rooms were driven 24 ft. wide on 80-ft. centers, taking 12 ft. of coal on the advance. On the retreat, most of the top coal was taken, leaving 4 ft. of dirty coal for roof support.

JEFFERY CUTTING MACHINE: While making a top cut with a 70 UR Jeffery cutting machine in an entry in Hanna No. 4-A mine, the operator stands well back from the working face.

SHUTTLE CAR: Close-up of a shuttle car being loaded with an 11 B.U. Joy loader. First mining in this room underground was approximately 12 ft. in height.

EN ROUTE TO DISCHARGE POINT: A view of a mine car loaded with coal being trammed to the discharge point. Ample clearance is an essential for safe shuttle car haulage.

MINE TIPPLE: With the completion of a new tipple and a rock tunnel at Hanna, Wyoming, in 1942, the name of the mine was changed from Hanna No. 4 to Hanna No. 4-A mine.

ters, taking approximately 12 ft. of coal as they advanced. When the barrier line was reached, retreating was started and most of the top coal was taken, leaving approximately 4 ft. of dirty coal for roof support.

Actually, Hanna No. 4 and No. 4-A mines are the same mine. The "A" was added when a new tipple and a rock tunnel were completed in 1942. These new installations permitted more efficient operations by cutting man-trip time, length of haul, and the amount of mine maintenance. No. 4 mine was opened in December, 1911, operating in the No. 2 seam. Up to and including 1942, production totaled 10,233,124 tons of coal. Starting with 1942, the mine name was changed to No. 4-A and all the coal produced was passed over the new tipple. From that date until the shutdown there were 9,133,664 tons of coal produced.

The Coal Miner

There is romance in the mining of coal. Coal mining is truly the "womb of the earth"; in fact, it is life itself that helped to make this nation great. No man is prouder than a miner who is helping to produce a good day's run of coal. His working place is his castle, be he machine man, loader-operator, tracklayer, motorman, mule driver, pick worker, shoveler, or the doer of any of a thousand jobs in and around a coal mine. He is a COAL MINER. —I. N. Bayless

The first mechanized loading units used in Hanna No. 4 mine were Thew shovels, installed in 1916 and 1918. These shovels were replaced with Joy loaders and shaking conveyors in 1930. For several years prior to the shutdown, almost all of the mined coal was loaded with 11 B.U. Joy loaders onto Joy rubber-tired and General Electric tractor-tread shuttle cars.

° ° °

Hanna No. 4-A mine, in winning the Sentinels of Safety trophy for 1953, was worked 374,702 man-hours without a lost-time accident. On March 1, 1954, when the mine was shut down it had been operated continuously for 65 years. So marks the end of a brilliant career that had but one goal: to produce a clean and constant supply of fuel for a railroad that has pioneered the development of the West.

LAYING A PIPE LINE FOR CANADIAN OIL DELIVERIES

A pipe line in Canada is extended for 643 miles through rugged terrain and across rivers, streams, and swamp areas in the upper counties of Wisconsin and Michigan

PAUL C. ZIEMKE*

CANADA'S busy eastern cities and industrial centers require ever-increasing quantities of petroleum products. The situation was eased somewhat recently by the development of a series of gushers in a relatively new oil field in northern Alberta, near the provincial capital of Edmonton. However, several difficult transportation problems were involved in bringing the oil from the wells in Alberta to the refineries in Sarnia, Ontario, a distance of 1,773 miles.

The original plan for handling deliveries of the oil included the construction of a trench and the installation of a 30-in. steel pipe line through which the oil would be pumped from the new Canadian field to Superior, Wisconsin, where it would be transferred to tankers for delivery by water to the Sarnia refineries. The plan was adopted and the pipe line became a reality.

With the passing of time and the formation of ice in the waters of the lakes during the five long and cold winter months, a serious bottleneck arose. This handicap was overcome by the authorization of a $75 million construction project to extend the 30-in. pipe line for 643 additional miles through the upper counties of Wisconsin and Michigan.

Route Locations Selected From Aerial Photographs

Reconnaissance for the line's extension was accomplished in airplanes and helicopters, supplemented with jeeps. Aerial photographs were taken along

*101 Kimball Lane
Oak Ridge, Tennessee

BLASTING RIVER BEDROCK: Detonation of heavy charges of dynamite, loaded into 6-in.-diameter holes drilled into rock at the bottom of the Escanaba River, produced the required trench for the pipe-line crossing along with spectacular effects.

DRILL BARGE: The contractor mounted two well drill units on a drill barge to put down 96 holes, 6 in. in diameter, into the river bedrock. The depth of the river water averaged 9 ft.

HERCULES DYNAMITE: The dynamite used for blasting trenches in the bedrock under 9 ft. of water in the Escanaba River was Hercules 60% Gelatin Extra in 5-in. by 25-lb. cartridges.

AN APPROACH TRENCH: To provide approach trenches for crossing the river with the pipe line, 60 holes were drilled and blasted in the rock formation on the banks of the Escanaba River.

a 3-mile-wide strip of northern wilderness. Back at the project's headquarters, engineers inspected stereoscopic pairs of photographs to spot the best locations for carrying on the more troublesome types of construction — working in miniature mountains of rock, river crossings, and population centers. Viewing the photographed terrain in three dimensions, the engineers selected locations between vital points by marking lines on the prints until a series of them presented a set of lines which appeared to be particularly desirable. While photogrammetry was not new to these engineers, it was the first time they had been called upon to select a route for a pipe line on paper.

Because of the rugged terrain along the southern shore of Lake Superior, geological interpretations of the photographs were made to determine the areas where rock outcroppings were indicated. Sets of planimetric maps were made from the photographs on a 1-mile-wide strip to show the locations selected and their principal topographic features — roads, woods, swamps, railroads, buildings, streams, and lakes. Draftsmen made the maps to scale 1 in. to 1,000 ft. in rural areas, and 1 in. to 200 ft. in urban areas. Equipped with these maps, right-of-way engineers (agents) proceeded with their activities well in advance of the arrival of transit crews. This technique eliminated the handling of disputes which sometimes occur over access or trespass.

Construction Work Divided Into 12 Contracts

Because of the urgency of the 643-mile extension line, the details of construction were divided into 12 contracts. The contracts covering the line to be laid within the United States, in Wisconsin and Michigan, were divided into seven sections or "spreads." These spreads, varying in length from 70 to 100 miles each, were awarded to five contractors from the United States. The remaining contracts were awarded to four contractors from Canada. These latter awards included the crossing of three large bodies of water and a pumping station at the head of the lakes at Superior, Wisconsin.

Some of the obstacles which the

PIPE IN PLACE: After the trench had been excavated and cleared to a minimum depth of 5½ ft., sections of 30-in. pipe were welded together, placed along the line, and covered.

construction crews had to contend with included working through more than 100 miles of swamp land. Many tractors and trucks were bogged down in these wet, soggy areas. Approximately 200 miles of the line right-of-way were in underdeveloped and cut-over farmland, and 140 miles of it involved heavy forests. About 10 per cent of the trench excavation was in rock formations, 4 per cent was in a mixture of boulders and clay, and 15 per cent was in sandy loam. Approximately 153,000 tons of steel were required to lay the 643 miles of 30-in. pipe. The estimated cost of installing the line is $100,000 a mile.

The trenches were excavated to a minimum depth of 5½ ft., to provide a 3-ft. cover. Equipment used included backhoes, trenchers, small power shovels, clamshells, and draglines.

Blasting Rock Formations At River-Crossing Location

Laying the line across the Escanaba River in trenches excavated in the river bed presented several problems, especially in blasting rock formations. This was due to the proximity of developed farm lands and associated structures, and the hydroelectric power plant of the Escanaba Paper & Power Company located downstream at Boney Falls. Chester Rice of Escanaba, with many years of experience in drilling and blasting native rock formations, was awarded a subcontract to drill and blast the rock yardage in the river bed. In carrying out the details of his subcontract, Rice used a drill barge on which two well drills were mounted to drill 96 holes, 6 in. in diameter, under an average water depth of 9 ft. The width of the river at the crossing location was 276 ft. Each drill hole penetrated the river bedrock to a depth of about 11 ft. An additional 60 holes were drilled in rock on the banks of the river to provide approach trenches for the pipe-laying operations. The explosives charges for blasting the underwater holes in the river bed totaled 9,600 lb. of Hercules® 60% Gelatin Extra Dynamite. For blasting the holes in the river banks, 3,000 lb. of the same explosives were used. Results were uniformly satisfactory.

Excavation of the blasted rock in the river trenches and in the approach ditches was done with a power shovel above the water level. The remainder was removed by a dragline operating from each bank for one-half of the trench. Much of the blasted rock was used as fill after the pipe was in place.

Laying Pipe in Underwater Trench Spanning the River

Once the trench had been cleared to grade, sections of the 30-in. pipe were welded together and laid in the trench spanning the river. The line was reinforced against the abrasive action of the ditch and trench walls by insulating the pipe with lashed-on sections of heavy plank. This technique added to the natural buoyancy of the pipe with its airtight seals at the ends. Cast concrete shells, each weighing 600 lb., were placed about the pipe line to assure submergence and to protect it against spring ice floes.

The Lakehead Pipe Line Company, the directors of operations on the project, was represented by the following personnel: T. S. Johnson, president; R. E. Trammel, general manager; F. J. Stubbs, assistant general manager; and R. H. Clute, chief engineer.

CONCRETE SHELLS: At the river-crossing site, cast concrete shells, each weighing 600 lb., were placed around the pipe to assure submergence and as protection against spring ice floes.

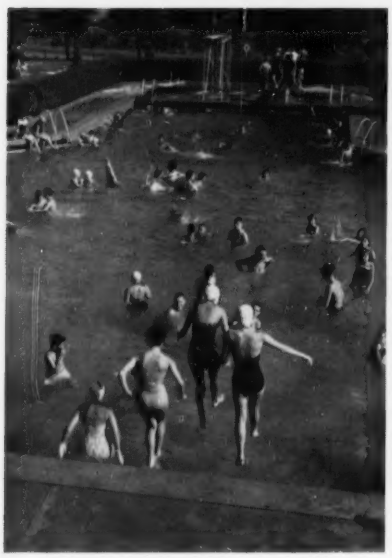
Island Creek Coal Company's Golden Anniversary

(Continued from page 107)

barges, and for the rescreening, resizing, and reloading of coal into either railroad cars or trucks. From this elevator, coal is shipped by rail into southeastern Indiana and southern Ohio. In consequence, many consumers and retailers benefit from the advantages and economies effected by this river-transportation system.

Employe Relations

The story of Island Creek Coal Company would be incomplete without reference to its most valuable asset — its employes whose daily efforts, performed in a spirit of teamwork, make possible the company's quality products and services.



THE SWIMMING POOL: The swimming pool in Holden, provided by the company, is one of the most popular recreational centers in town, especially for the young folks.

How company employes live, work, and play is a very real concern of the Island Creek management. A tour of Holden, West Virginia, one of several centers in which Island Creek products are produced, reveals neat and attractive homes, stores, schools, and churches. In addition, the company provides the Holden community with tennis courts, a clubhouse, a swimming pool, a lighted baseball field, an air-conditioned theatre, and many other things which an American town needs to give its people a well-rounded, happy life. Most of the people engaged in producing Island Creek coal are buying their homes, have bank accounts, and enjoy a contented home life. Their children have the advantages of good schools, plus a variety of wholesome social activities.

EMPLOYES' HOMES: A tour of Holden, West Virginia, reveals attractive houses for Island Creek employes, made available by the company. Many local miners are buying their homes.

In commemorating the Golden Anniversary of Island Creek Coal Company recently, Raymond E. Salvati, president of the company, commented on the future of both Island Creek Coal Company and the coal industry. In his remarks, Mr. Salvati said:

"Island Creek has come a long way in the 50 years since its founders with their ox teams moved mining equipment into what was then a wild, mountainous section of West Virginia. It has had a steady, healthy growth because throughout these years Island Creek men and women have been inspired by and well schooled in the basic principles of quality and service so well established by the company's founders.

"Our interest, our obligations, and our confidence in the future are predicated upon a knowledge and an appreciation of the past. That coal has always been America's basic resource is an established fact. We are confident it will remain so in the future.

"We expect to devote more and more

MODERN SCHOOLS: The grade and junior high school in Holden is typical of the modern educational facilities for the miners' girls and boys.

time to research in developing new ways of putting coal to work, in creating new equipment to burn it with greater convenience and efficiency, in finding new ways to use it in other forms, and in developing new methods for producing and distributing it at lower costs. It is our intention to continue our policy of fostering and supporting industry activities which have as their purpose the betterment of our business and services to the coal-consuming public.

"The nation's overall energy load is conservatively expected to double within the next 25 years. Coal will supply a major part of this energy. Despite technological and scientific developments, we are certain that in the years ahead coal will be the cheapest of all energy sources. Fuels competitive to coal are becoming increasingly expensive to discover, transport, and produce. Coal, on the other hand, is being benefited by newer and better methods of mining plus technological advancement in the interest of economy of use.

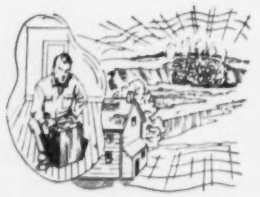
"We acknowledge the certainty that the future will reveal much that is unknown today. To this end, it is our purpose to maintain at all times adequate productive capacities, to provide well-trained service departments, and to keep abreast of all technological progress so that the needs of our customers may be satisfied in all respects at all times.

"Island Creek is well fortified with plant and equipment. It has plentiful reserves of quality coals. Its personnel is among the best trained in the industry, proud of its position of distinction. Its production and sales teams are men of vision, united in their determination to keep Island Creek products a preferred choice.

"As in the past, management is building for tomorrow."

(The editorial staff of The Explosives Engineer extends congratulations to Island Creek Coal Company on its fiftieth anniversary. We sincerely hope the future holds many more years of successful operations for the company and its personnel.)

VIBRATION TROUBLES?



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VIBRATION SURVEYS—BLASTING EFFECTS ANALYSIS

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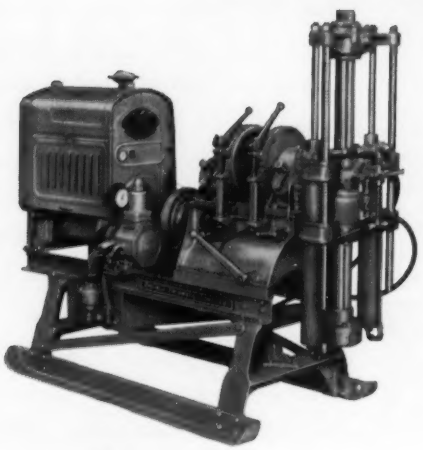

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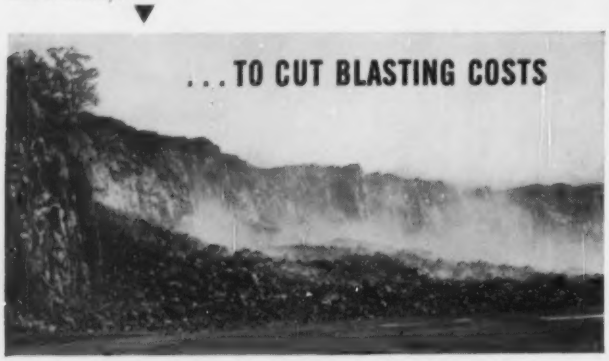

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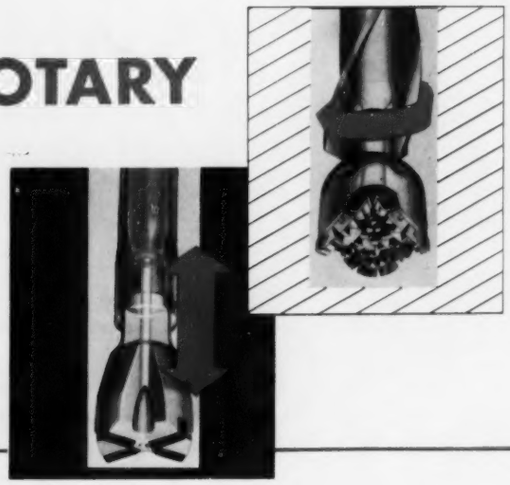

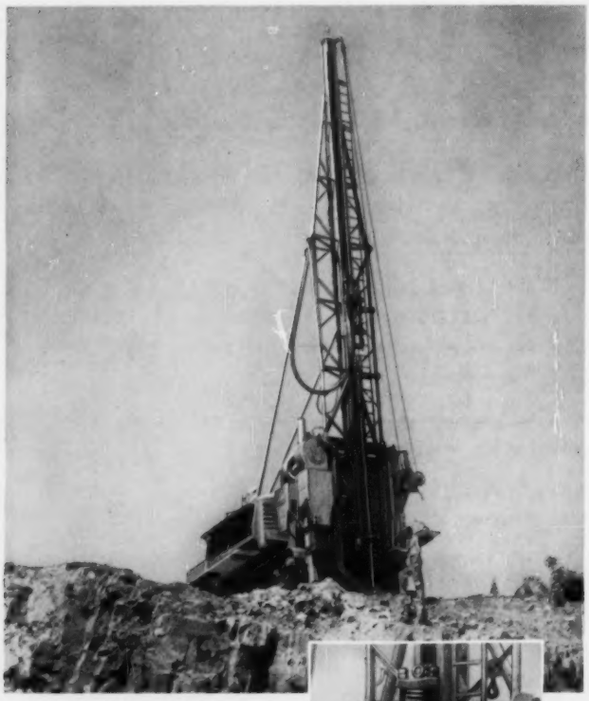

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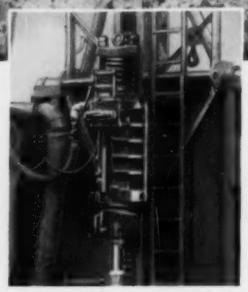

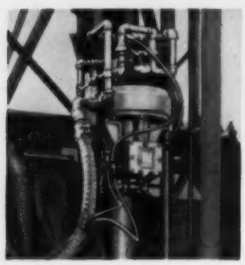

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